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Corona shielding arrangement and techniques to fabricate it

This invention relates to a corona shielding arrangement for the stator winding of rotating high-voltage machines with round-wire winding combined with a slot portion insulation
5 consisting of a slot liner with a conducting slot-portion corona shielding, a semi-conducting overhang corona shielding, and a technique to fabricate the corona shielding arrangement.

Overhang corona shielding arrangements in high-voltage machines with former windings made of rectangular wire and sleeve insulation with semi-conducting corona shielding
10 varnish or semi-conducting corona shielding tape to improve the voltage distribution at the slot end are known in a large variety of designs.

DE 30 45 462 describes a solution wherein a shielding base material, consisting of semi-conducting material, is wound onto the ground insulation as overhang corona shielding and
15 subsequently impregnated.

DE 42 18 928 comprises an overhang corona shielding arrangement wherein a semi-conducting corona shielding tape is applied on top of the ground insulation with the overlapping decreasing towards the end of the bar.
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In DE 196 34 578 an overhang corona shielding arrangement is described wherein the voltage distribution is improved by using grading rings (equipotential rings) on the insulation in the area of the slot end.

25 The above referenced arrangements or techniques have several disadvantages:

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In order to obtain the specified overlapping and to satisfy the technological specifications, the semi-conducting corona shielding tape must be applied very carefully by wrapping.

Folds or gaps in the wrapping are inadmissible. However, it is difficult to meet this requirement, particularly when a tape of greater length is applied. Additional impregnation

5 to obtain the desired overhang corona shielding effect requires extra technological work.

This is also true of the proposed grading arrangements.

The known coatings with semi-conducting corona shielding varnishes which are provided to obtain the desired overhang corona shielding cannot be applied at all in the case of a slot

10 portion insulation which consists of panel-type insulating material because they must be applied by spreading or spraying prior to impregnating them with liquid insulating medium at the slot end, and in doing so they penetrate into the ground insulation in the overlapping zone of the panel-type insulating material, usually in the area of the slot opening, where they unacceptably shorten the creepage path between winding wire and laminated core.

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When using semi-conducting corona shielding tapes to provide the overhang corona shielding, any contacting of the tapes with the conductive corona shielding of the slot portion is problematic because at high voltages poor contacting results in partial discharges, which again, further worsens the contact making so that finally the overhang corona

20 shielding becomes ineffective. In all common arrangements used to date, the point of contact is located outside the laminated stator core.

It is an object of this invention to provide a corona shielding arrangement and a technique to fabricate it relating to the stator winding of rotating high-voltage machines with round-wire

25 winding and slot lining, thus providing an overhang corona shielding which safely controls

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all electric stresses occurring at the slot end, primarily during power-frequency and impulse voltage testing as well as during switching operations during service, and which provides good contact making between slot portion and overhang corona shielding thus causing higher partial-discharge inception voltages, and which reduces material consumption and
5 time required for fabricating the overhang corona shielding of the high-voltage winding.

In accordance with the present invention, the object is achieved by the characteristic features of Claim 1 and Claim 2. According to this invention the corona shielding arrangement for the stator winding of rotating high-voltage machines with round-wire winding, slot lining
10 and corona shielding material is fabricated so that the slot lining on the side facing the laminated core consists of conducting and semi-conducting corona shielding materials arranged both outside the laminated stator core and inside the laminated stator core with the semi-conducting material used for the overhang corona shielding consisting of monoplane semi-conducting corona shielding material, cut into strips, and arranged on either side at slot
15 level and, if required, also on the bottom of the slot on the slot lining. The point of contact between conducting and semi-conducting corona shielding materials is located within the laminated stator core. Optionally, the slot lining may consist of one or several layers.

According to the suggested technique the semi-conducting corona shielding materials to be
20 arranged at the conducting corona-shielding material are glued on only partially. The semi-conducting corona shielding materials may also be inserted in the slot ends during or after arrangement of the slot lining. Subsequently the winding is drop-fed into the slots through the slot opening and the slot closed by folding the slot lining and inserting the slot closing strip. Then the end winding is wrapped whereby the slot lining protruding from the slot is
25 also insulated up to the laminated stator core. In doing so the semi-conducting corona

shielding material must be kept away from the slot lining. Upon completion of this operation, the semi-conducting corona shielding material is applied to the end winding insulation and fastened with adhesive tape or cover tape which is placed on the end winding insulation.

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In a preferred arrangement the conducting corona shielding material is glued onto the slot lining covering the surface either partially and/or fully. Preferably, the conducting corona shielding material may be of the same length as the laminated stator core.

- 10 According to this invention, an overhang corona shielding does not require complete wrapping of the round-wire windings in the zone of the end winding with overhang corona shielding tape. Favourable voltage distribution is obtained throughout the entire insulation in the area of the slot end. Partial discharges are reliably limited and it is now possible to satisfy the typical testing conditions for high-voltage machines without causing any damage
- 15 to the winding insulation. Due to the strip-type design of the overhang corona shielding, fabricated according to the present invention, the invention guarantees effective potential grading for round-wire windings with slot lining.

- In the following the invention will be explained in greater detail in a preferred embodiment
- 20 describing a corona shielding arrangement for the stator winding of rotating high-voltage machines wherein the stator winding which is executed as a blank round-wire winding is inserted in slots of a laminated stator core with straight slot bottom. According to the present invention, strips of semi-conducting corona shielding material are arranged on the two sides of the slot and on the slot bottom. These three strips consisting of semi-conducting corona
- 25 shielding material are arranged on top of the conducting corona shielding material of the slot

5 Depending on electrical stresses to be expected, the slot lining may consist of one or several layers.

Next the winding is fed-in and the slot closed. Now the three strips of the semi-conducting corona shielding material must be kept away from the slot lining. Then the end winding is wrapped with insulating tapes wherein the slot lining protruding from the slot is being insulated up to the laminated stator core. Following this operation, the three strips of the said semi-conducting corona shielding material are placed onto the insulation of the end winding and fastened with adhesive tape or cover tape which is wrapped on top of said end winding insulation.

When the slot bottom is rounded, only two strips of the semi-conducting corona shielding material are arranged on top of the conducting corona shielding material of the slot. The width of said semi-conducting corona shielding material shall be preferably equivalent to the height of the straight slot slope. Here again, the material should preferably be glued onto the conducting corona shielding material only in some points to ensure contacting.

Subsequently, as is known, the stator winding is impregnated with resin using a common impregnating procedure.